WASHINGTON
SCIENCE TRENDS

HIGHLIGHTS

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* NUCLEAR TESTS

Official Atomic Energy Commission statements released this week indicate that the U. S. has "tentatively planned" a major underground nuclear explosion in New Mexico for December, 1961, should the Administration decide to resume nuclear testing. Similar explosions are under consideration for Nevada and Mississippi.

✓ Project Gnome: This underground nuclear test calls for detonation of a nuclear device in the range of 5 KT yield in the Salado Formation salt beds, 25 miles southeast of Carlsbad, New Mexico. A 1200 foot shaft leads to an 1100 foot tunnel ending in the zero room where the explosive would be placed.

Object of Project Gnome:

- ø Explore the feasibility of converting explosive energy into heat for production of electric power.
- ø Investigate the practicability of recovering useful radioisotopes.
- ø Expand the data on characteristics of underground detonations to a new medium (salt) in comparison with the volcanic rock previously used.
- ø Make neutron cross-section measurements.

✓ Project Wagon: Preliminary preparatory work will begin shortly on Project Wagon, an excavation experiment which would take place in basalt, a hard rock, at the AEC's Nevada Test Site. Low-yield devices, in the 0.5 to 5.0 KT range, would be used. AEC says this experiment could be completed in 6-10 months from date of approval, probably in the time period July, 1962 - July, 1963.

✓ Project Vela: As previously announced, this program could include 13 nuclear and 20 or more chemical explosions to be fired underground at the Nevada Test Site and elsewhere through July 1963, if approval is forthcoming. AEC has also been doing exploratory drilling in two Mississippi salt domes "preparatory to the selection of a site for conducting a series of deep underground nuclear shots" to learn more about a possible method of concealing an underground explosion.

* INDUSTRY INVITED TO OCEANOGRAPHIC INSTRUMENTATION MEETING

All companies interested in oceanographic instrumentation and data handling are invited to take part in a Government-Industry Symposium in Washington August 16-17, 1961. Advance registration is required. The symposium will cover, on an unclassified, technical level, the requirements of Federal and non-Federal activities, and both military and non-military applications in both instrumentation and data handling.

(For advance registration send names, titles and mailing addresses of representatives in priority order of attendance to Donald L. McKernan, Inter-Agency Committee on Oceanography, care of Bureau of Commercial Fisheries, Department of the Interior, Washington 25, D. C.)

* RICKOVER ON GOVERNMENT PATENT RIGHTS

Vice Admiral Hyman G. Rickover, a powerful voice on Capitol Hill, is urging Congress to make sure that the Federal Government owns any patents resulting from work it has financed, in both Government laboratories and private industry.

At the same time, he is accusing the nation's patent lawyers of "arrant nonsense" in opposing such measures. His comments come in newly released testimony before a House Appropriations subcommittee.

✓ "Arrant Nonsense": Whenever anyone takes issue with provisions of our present patent system, "Rickover states," or with the Department of Defense policy of paying for inventions without receiving title to them -- and thereby delaying the availability of this information to all American industry -- he is immediately accused by the patent lawyers of being against the free enterprise system. This is arrant nonsense.

"It is a matter of record I buy nearly 100 percent of the items for the naval nuclear program on a competitive fixed-price basis. This is pure 'free enterprise.' In fact, it is so pure and so capitalistic that some companies don't like it.

✓ "Oratorical Fog": "I have gone through the oratorical fog of articles and statements by the patent lawyers. All of their speeches have the very same vapid cliches; the Declaration of Independence; the Founding Fathers; Free Enterprise; our patent system is the best in the world; it is responsible for the highest standard of living in the world; it is vital to our way of life; it has made the U. S. the strongest nation on earth, et cetera. I do believe it is about time for the patent lawyers to get together and make up a new speech....

"The few thousand patent lawyers in the United States are a typical pressure group. They well realize that if anything is done to reduce the complexity of our patent system they will be affected financially. They tried to change the patent provisions of the Atomic Energy Act and were unsuccessful. They are now trying to change the patent provisions of NASA, realizing that many billions of dollars of Government money is involved.

✓ An Exploitable Service Agency?: "We must not become a pressure group state. The United States is rich, but not so rich we can afford to let the cow of national wealth be milked by anyone. The United States must not be looked at as an exploitable service agency...."

* PATENT BAR REPLIES

R. B. Larson, President of the American Patent Law Association, expressed "amazement and regret that Admiral Rickover should make such glaringly inaccurate statements." He declared: "The policy of the Department of Defense on research and development has been to contract, and pay for, such research and development work. It does not pay for inventions which may, or may not, emanate from such work. Instead it receives without additional cost, royalty-free rights to practice the invention anywhere for government purposes.

"Where the government is to take title the incentive to produce any inventions which the patent system provides, no longer exists. The Admiral apparently believes that we are sufficiently ahead of the Russians, that incentive is no longer necessary or desirable in these critical times.

"No individual or group of people are working to improve or simplify the operation of the patent system in the United States more rigorously than are the members of the patent bar."

* SATURN PROGRAM

(The National Aeronautics and Space Administration plans to spend some $224,160,000 this fiscal year in research and development programs connected with the Saturn launching vehicle. Here is a summary of information on this major program, as reported by the Committee on Aeronautical and Space Sciences, U. S. Senate.)

✓ Building Block Approach - The purpose of the Saturn program is to develop a multipurpose vehicle system using a "building-block approach" for the upper stages to achieve a variety of configurations and capabilities. This concept will provide a family of vehicles to meet future space requirements for large payloads on a sound basis of reliability, safety, timeliness, and economy. This item represents 17.3 percent of the total NASA amount for "Research and development."

The Saturn vehicle development, which carries the highest national priority, involves the development of vehicle stages, a guidance system, engines, and the development of special support equipment for handling, checkout, transportation, and launching. Saturn will be a multipurpose vehicle, capable of sending large payloads into interplanetary space and even larger payloads (three- to five-man crew) into orbits near the earth.

The Saturn project was initiated by the Advanced Research Projects Agency (ARPA) of the Department of Defense (DOD) in August of 1958. The first-stage concept, based on the utilization of multiple "off-the-shelf" engines to obtain a thrust of 1,500,000 pounds has remained relatively unchanged since that time. The use of multiple engines in each stage will provide the capability of carrying out the desired space mission with one engine inoperative.

After the President, in early November 1959, announced his intention of transferring the Saturn program from the DOD to NASA, a joint NASA-DOD committee recommended that all the upper stages of Saturn should utilize high-energy propellants (specifically liquid hydrogen and liquid oxygen).

✓ Current Planning - The configurations now planned are the two- or three-stage C-1 (stages S-I+S-IV+S-V) and the two-, three-, or four-stage C-2 (stages S-I+S-II+S-IV+S-V). It is significant to note that the Saturn stages S-I, S-II, and S-IV are each physically larger than any missiles previously developed in the United States, and also the latter two are pioneering developments using the new cryogenic fuel, liquid hydrogen. The planned launch schedule for the 10 Saturn development vehicles is 1 in calendar year 1961, 2 in 1962, 5 in 1963, and 2 in 1964.

✓ Design Changes - The Saturn C-1 is being reconfigured to accommodate design changes evolving from the S-IV stage development program (i.e., the incorporation of six engines instead of four). With the increased thrust available from the S-IV stage, the Saturn C-1 vehicle, when comprised of two stages (S-I and S-IV), will put increased payloads into low orbit with higher reliability than can be accomplished with the three-stage configuration (S-I, S-IV, and S-V). Refined mission analysis has indicated that the primary role of the Saturn C-1 vehicle will be orbital missions for such space programs as Apollo.

The additional stage (S-II) in the second version of Saturn (the C-2) will provide approximately two times the payload capability of the C-1 and will add to this country's vehicle capability by making possible more difficult missions, such as manned circumnavigation of the moon and orbiting of other planets. The primary role for the Saturn C-2 will be escape missions with early application to hyperbolic reentry testing for the Apollo program. The planned developmental launch schedule for the C-2 version provides for one launch in calendar year 1964, four in 1965, and two in 1966.

* SATURN PROGRAM (Continued)

A more detailed discussion of the various developments which make up the whole Saturn program follows:

ø Vehicle development

The configuration of Saturn currently under development (the C-1) is a two-stage or a three-stage vehicle. The first stage (S-I) is under development as an inhouse project at the Marshall Space Flight Center, utilizing engines manufactured by the Rocketdyne Division of North American Aviation, Inc. The second stage (S-IV) and the third stage (S-V) are being developed by the Douglas Aircraft Co. and by the Convair-Astronautics Division of General Dynamics Corp., respectively. The latter two stages will utilize engines provided by the Pratt & Whitney Division of United Aircraft Corp. An all-inertial guidance system will be employed with the C-1. The two-stage configuration will be capable of placing approximately 10 tons of payload into orbit about the earth, and the three-stage version will send about 3 tons beyond the earth's effective gravitational field. Assembly of the first and second flight vehicles (SA-1 and SA-2), each consisting of a live booster and dummy upper stages, is now underway. Both static and dynamic tests of the first stage (S-I) are being made in 1961.

The planned growth version of Saturn (the C-2) will be used in two-stage, three-stage, and four-stage configurations. For the C-2, a large new second stage (S-II), also using hydrogen and oxygen, must be developed. The former C-1 second stage (S-IV) becomes the new third stage and the former C-1 third stage (S-V) becomes the new fourth stage. An advanced all-inertial guidance system is planned to be used with the Saturn C-2. Two-stage or three-stage vehicles will be used for most earth orbit missions; the three-stage version also will be used for lunar and interplanetary missions. Extremely high energy missions, i.e., probes to Jupiter or Mercury, will require the four-stage version. It is significant to note that the heavy payload launching potential of the Saturn cannot be attained unless the new second stage (S-II) is provided.

✓ S-I stage - The first stage (S-I) of Saturn employs eight Rocketdyne H-1 engines, each delivering 188,000 pounds of thrust at sea level, for a total thrust of 1.5 million pounds. The stage is about 21½ feet in diameter and 80 feet long. Liquid oxygen and RP-1 (kerosene) form the propellant combination; they are carried in a cluster of eight elongated tanks, of the same diameter as the Redstone missile tank, surrounding one elongated tank of the same diameter as the Jupiter tank. The engines can be individually shut off on command when an incipient malfunction is detected. Since the engines are simplified adaptations of the well-proven engines used in Atlas, Thor, and Jupiter, the number of malfunctions during flight is expected to be low.

✓ S-II stage - This new second stage, to be used only in the Saturn C-2 configuration, will be the same diameter as the S-I stage (21½ feet), will contain over 300,000 pounds of liquid hydrogen and oxygen, and will be powered by four engines. Present plans call for the initiation of S-II stage development in the first half of the fiscal year 1962.

✓ S-IV stage - The second stage (S-IV) of the Saturn C-1 configuration utilizes the liquid-hydrogen liquid-oxygen propellant and a cluster of six Centaur engines built by Pratt & Whitney Aircraft to provide a total thrust of 90,000 pounds. This stage is about 18½ feet in diameter with a length of over 40 feet and a propellant capacity of 100,000 pounds. A preliminary study contract followed by a development contract late in July 1960 initiated the development of this stage; its first flight is planned for early 1963.

* SATURN PROGRAM (Continued)

✓ S-V stage - The third stage (S-V) of the Saturn C-1 is a Centaur upper stage, modified to fit Saturn launch equipment. Two of the same engines which are to be utilized in the S-IV are to be used to power this stage. It will be 10 feet in diameter, and will contain about 28,000 pounds of usable hydrogen-oxygen propellant. Coasting, attitude control, and engine restart capabilities will be incorporated in this stage, as in Centaur, to permit the attainment of more difficult orbits and deep space trajectories. A preliminary study contract was awarded in October 1960. Due to primary emphasis on orbital missions for the first Saturn vehicles, the S-V development will be limited to engineering design studies in the fiscal year 1962.

✓ Guidance - The guidance system will be physically located above the upper stage of each C-1 and C-2 configuration, and will send commands to the control systems of all vehicle stages to insure that the proper trajectory is flown. An all-inertial system will be used, in order that a number of ground guidance stations spread around the world will not be required. It is planned to use a digital computer linked to the required sensors, so that a greater storage capacity for trajectory information will be available. The trajectory changes associated with engine-out flight capability will require this greater guidance flexibility.

✓ System integration - The Marshall Space Flight Center is responsible for the overall design and development of the Saturn vehicles, including the system checkout and launching and the integration of the various developments to insure that all pieces are compatible with each other and with the planned launching technique. The Marshall Center is also responsible for the design and development of the S-I stage. The Douglas Aircraft Co. has the responsibility for the S-IV stage, and Convair-Astronautics for the S-V stage. The guidance system development responsibility will be a partnership effort between the Marshall Center and industry. The Goddard Space Flight Center, the Jet Propulsion Laboratory, and the Space Task Group will have the responsibility for the design and development of the payloads to be placed atop Saturn.

ø Engine development

The rocket engines to be used in Saturn are developed under separate contracts and are supplied to the respective stage contractors as Government-furnished equipment. This procedure helps to minimize the number of engine developments required; one engine can thus be used in more than one stage. Described herein are the so-called H-1, J-2, and RL-10 engines. The H-1 and J-2 engines are used in the Saturn S-I and S-II stages, respectively, and the RL-10 engine is used in both the S-IV and S-V stages. A series of static tests, using eight clustered H-1 engines for a total firing time of more than 500 seconds at the 1,320,000-pound thrust level, has been completed.

✓ H-1 engine - The H-1 engine is the logical outgrowth of the engines already developed for the Atlas, Thor, and Jupiter missiles. The engine burns liquid oxygen and kerosene. It is a simplified version of the missile engines previously mentioned which is being uprated from 165,000 to 188,000 pounds thrust. Because of the simplications incorporated in this engine, its development history, thus far, has been oustandingly good. With the presently achieved record of reliability the use of eight of these engines in the Saturn S-I stage should provide a rocket powerplant which is considerably more reliable, at any given point in time, than any other of comparable thrust rating.

✓ RL-10 engine - The RL-10 engine is to be used in both the S-IV and S-V upper stages of Saturn and is basically the same engine that will be used in the Centaur vehicle. This 15,000-pound thrust engine will be the first flyable engine to utilize the high-energy propellant combination of liquid hydrogen and liquid oxygen. Changes to the basic Centaur engine for adaptation to the six-engine cluster to be used in S-IV Saturn will be kept to a minimum.

* SATURN PROGRAM (Continued)

✓ J-2 engine - Four J-2 engines will be used to power the S-II stage. This engine, capable of producing 200,000 pounds of thrust, is the largest engine currently under development that uses liquid oxygen and liquid hydrogen for propellants. Since the S-II stage development is being advanced for propellants. Since the S-II stage development is being advanced in conjunction with the Saturn C-2 schedule acceleration, experimental hardware procurement will be funded for Saturn in fiscal year 1962.

ø System support

A number of areas of developmental effort are required to bring a space launching vehicle to such a level of reliability that expensive payloads can reasonably be assigned to it. Some of these areas of effort do not result in hardware which flies with the operational vehicle, yet they are nevertheless necessary if the hardware developments are to be successful. Such areas are grouped under "System support." In the case of the Saturn program, the system support effort includes the development of ground support equipment, the development of appropriate system instrumentation, the development of satisfactory launching operational techniques, and the procurement of the necessary propellant components. The ground support equipment necessary to permit the transportation of the large first stage and to provide for the fueling, checkout, and launching at the Atlantic Missile Range will be complete in 1961.

✓ Ground support equipment - This encompasses the development of those items of equipment which are used for the handling and checkout of the Saturn vehicle. Any such equipment which is related to the construction of facilities for the Saturn program are budgeted in the "Construction of facilities" appropriation. The development of equipment items not related to facility construction, but to the Saturn vehicle itself, are budgeted here. Examples of these latter items are road transporters for the various stages, handling slings and dollies, and electrical and pneumatic checkout panels. In general, these items may be used either at the Marshall Center, supporting either the static firing effort or the preshipment mating and checkout, or at the Atlantic Missile Range, supporting either the hangar checks or the onpad checks. Some items, such as the transporters, will stay with the vehicle, and hence be used at both locations.

✓ System instrumentation - During a rocket vehicle development, obtaining knowledge of the environment to which the vehicle is exposed during flight is essential to the development team, if they are to know what made the vehicle perform as it did. Internal pressures, external pressures, vibration levels, compartment temperatures, the activation of essential electrical relays, valve operations, and the response of the guidance sensors all serve as examples of the type of information which is needed. An extensive set of vehicle-borne instruments is required to measure these parameters and to telemeter the information back to the ground. Also needed, of course, are telemetry receivers and decoders, to present this information in usable form. Since Saturn is larger and more complex than missiles previously developed, more extensive and more sophisticated system instrumentation is needed to gather, transmit, and present the necessary information. It is noteworthy that this system instrumentation is primarily used during the vehicle development flights; far less vehicle instrumentation will be required during Saturn's operational phase.

✓ Launch operations - This support area includes the supply of material for general use at the launch complex, the supply of replacement parts for the launch complex, the transport of the various stages, and studies concerning possible improvements of either the launching equipment or the launching techniques.

TECHNICAL TRENDS

□ The Rover nuclear rocket program is being delayed by housing shortages at Los Alamos, New Mexico, where there is no room for industrial participants. √√√ Organizations interested in the new coal research program may request a new brochure explaining details to be available shortly upon request to the Office of Coal Research, U. S. Department of the Interior, Washington 25, D. C. √√√ The Navy's Bureau of Ships is asking for industrial proposals on research in ultra high temperature dielectric embedding materials. √√√ The Naval Research Laboratory, Washington 25, D. C. is looking for firms with capabilities and experience in the development and manufacture of tough, high-tenacity, synthetic fibers. √√√ Orenda Engines, Ltd. of Ontario, Canada will take part in a joint Army-Navy program for development of a 600 horsepower gas turbine engine for marine and vehicular applications.

□ The U. S. Bureau of Mines expects industrial comments on its proposal to test and approve for use a "methane-monitoring system" for mine use. √√√ Lockheed Electronics, Plainfield, N. J. will supply 20 radar systems for the Air Proving Ground Center. They employ X-band radar augmenters which make relatively small missile targets appear as large as aircraft for training missions. √√√ The U. S. Census Bureau, Washington 25, D. C. is making available, at the cost of reproduction, tapes of various census statistics for small areas which might not otherwise be published. The tapes are for computers compatible with the Bureau's Univac Model 1105. √√√ The Martin Company's isotope-powered automatic weather station, which has been operating under test conditions, will be installed in the Canadian Arctic, where it will hopefully operate unattended for up to two years.

□ The American Meteorological Society has assembled a "Planning Task Force" to recommend goals and outline a national plan for the atmospheric sciences over the next ten years, as requested by President Kennedy's Special Assistant for Science and Technology. √√√ Army Aviation says it has a requirement for an air to surface missile system which will detect, locate and destroy enemy electronic devices. Such a system must be able to locate targets at ranges up to 5,000 meters, under all weather conditions, must be capable of discriminating between targets and furnishing enough information to permit a pilot to determine priority of attack. In addition, the missile itself must be able to home in on a chosen target, regardless of enemy countermeasures. And the complete system must be rugged, easy to maintain, simple to operate and capable of being carried by an aerial delivery vehicle.

□ The Project Ranger lunar spacecraft to be launched from Cape Canaveral, sometime this week, has 19,520 working electronic parts. √√√ Information on a high flux reactor nearing design completion for the National Bureau of Standards is available from the Office of Technical Information, NBS, Washington 25, D. C. √√√ Dr. F. J. Weyl succeeds T. J. Killian as Chief Scientist of the Office of Naval Research. √√√ A survey of the market for U. S. microwave, forward scatter and other radio communication systems in Norway is available at 10 cents from the Publications Office, BDSA, U. S. Department of Commerce, Washington 25, D.C. √√√ The Information Office, Office of Aerospace Research, U. S. Air Force, Washington 25, D. C. has issued Release No. 7-61-2 detailing $2.5 million in basic research grant and contract awards. √√√ The Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D. C. plans to hold hearings this week on developments in the field of detection and identification of nuclear explosions. √√√ The U. S. Bureau of Mines, Division of Minerals, Washington 25, D. C.has issued MMS No. 3246, a statistical picture of abrasive materials in the U. S. during 1960. The same office has Published MMS No. 3252, outlining the nation's Titanium industry. √√√ The powerful House Appropriations Committee has slapped the Navy for poor liaison work on the mammoth radiotelescope at Sugar Grove, W. Va. designed to pick up Soviet radio/radar traffic. Originally authorized at $60 million, the House Committee ordered that not more than $135 million be spent.

PUBLICATION CHECKLIST

- HELIUM PRODUCTION, a report on operation of the U. S. Bureau of Mines helium production plant at Keyes, Oklahoma, including technical details of processing, shipping, etc. 16 Pages. Single Copies Free. (Write Publication-Distribution Section, U. S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa. for Information Circular No. 8018)

- EXTERNAL POWER IN PROSTHETICS AND ORTHOTICS, the proceedings of a working conference held at the University of California Conference Center in 1960 on power devices for the handicapped including various electrical methods, compressed gases, hydraulics, etc. Also includes "space age" advances in properties of plastics, metals, circuitry, subminiaturization, which may be of assistance in this work. 156 Pages. Single Copies Free. (Write Publications Office, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C. for Publication No. 874)

- FLOURESCENT X-RAY SPECTROGRAPH, a technical report on the design and principles of this instrument used for dynamic rate studies of selective oxidation in molten metals, and possibly for certain trace analysis problems. 21 Pages. Single Copies Free. (Write Publication-Distribution Section, U. S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa. for Report of Investigation No. 5739)

- ORGANIZATION OF THE U. S. SPACE EFFORT, a staff report on possible reorganization of the Government space program to provide both civilian and military gains. 13 Pages. Single Copies Free. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D. C. for Staff Study-The Organization of the U. S. National Space Effort)

- WATER POND FOR AIRPLANE RUNWAYS, an interesting study of generally good results of model tests involving open water and plastic-covered water ponds as an arresting system for airplane runway overrun. 23 Pages. Single Copies Free. (Write National Aeronautics and Space Administration, ATTN: CODE BID, 1520 H Street, N. W., Washington 25, D. C. for NASA Technical Note D-732)

- BASIC ELECTRICITY, a new revision of a Navy training manual covering electricity from the production of power to synchros and servomechanisms. 448 Pages. $3.50. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for "Basic Electricity")

- INTRODUCTION TO SONAR, a Navy training course on the role of the Sonarman, including information on equipment, operation, maintenance and safety precautions. 206 Pages. $1.25. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for "Introduction to Sonar")

- PUBLICATIONS OF THE NATIONAL BUREAU OF STANDARDS, covers all NBS publications issued between July 1, 1957 and June 30, 1960, as well as papers published by the Bureau staff in outside journals from 1950 through 1959. 391 Pages. $2.25. (Write Superintendent of Documents, Government Printing Office, Washington 25, D. C. for NBS Miscellaneous Publication No. 240)

- ELECTRICAL INSULATION, a collection of papers presented at a conference on electrical insulation held in Washington in October 1960, outlining some of the recent advances in this area. 207 Pages. $4. (Write Publications Office, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C. for Publication No. 842)